Studies in the genus Lupinus—VII. L. succulentus and L. niveus.

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(WITH FOUR TEXT FIGURES)

INTRODUCTION

In accounting for the North American annuals and biennials of the subgenus *Lupinus*, I have found it advisable to recognize six groups, as indicated and contrasted in the key below. These groups, however, do not provide for the Mexican annuals, *L. bilineatus* Benth., *L. Hartwegi* Lindl., and *L. Barkeri* Lindl., nor for the Costa Rican *L. Clarkei* Oersted, as satisfactory material of these species has not been available for my study.

Keel petals ciliate on their lower edges near the claw, commonly ciliate above, also, near the claw.	
Racemes shorter than their peduncles.	STIVERSIANI.
Racemes longer than their peduncles.	
Flowers verticillate; leaflets glabrous above.	SUCCULENTI.
Flowers scattered; leaflets more or less hairy above.	SPARSIFLORI.
Keel petals non-ciliate on their lower edges.	
Keel petals ciliate above near the point.	MICRANTHI.
Keel petals non-ciliate on both upper and lower edges.	
Flowers verticillate; leaflets hairy above.	MICRANTHI.
Flowers with scattered	
Leaflets hairy above, 2–5 mm. wide; pods 10–15 mm. long; seeds 1.5–3 mm. long.	CONCINNI.
Leaflets glabrous above, 6–12 mm. wide; pods 30–50 mm. long; seeds 4–6 mm. long.	SUBCARNOSI.

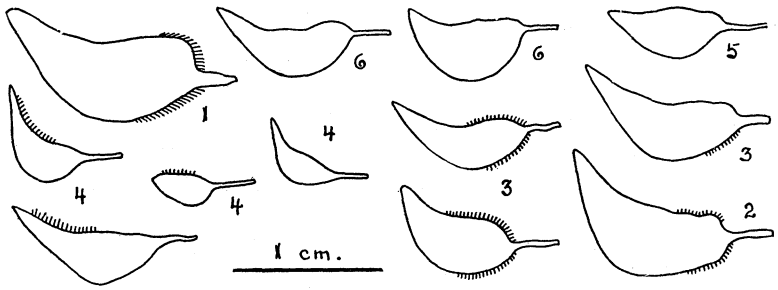

FIG. 75. 1. STIVERSIANI; 2. SUCCULENTI; 3. SPARSIFLORI; 4. MICRANTHI; 5. CONCINNI; 6. SUBCARNOSI.

FIG. 75 is here inserted to emphasize and contrast the above

indicated variations in the keel. Four of these groups, namely, the *Sparsiflori*, *Stiversiani*, *Concinni*, and *Subcarnosi*, have been treated in the last two papers of this series (Bull. Torrey Club **47**: 487-509. 1920; **48**: 219-234. 1921). This paper will consider the *Succulenti* and one species of the *Micranthi*.

SUCCULENTI

The one species included here is so distinct from all the other annuals of our region that I do not feel justified in placing it in any of the other groups recognized. The ciliation of the keel is too constant to be ignored, though nowhere properly described. This is the group some years ago indicated by me under the name *Affines* (Muhlenbergia **6**: 134. 1911).

1a. LUPINUS SUCCULENTUS Dougl.; C. Koch, Wochenschrift Gaertn. Pflanzenkunde **4**: 277. 1861. [FIG. 76.]

Stout, succulent or fistulous, 2–6 dm. tall, branched, nearly glabrous or sparsely appressed-pubescent (rarely villous): leaves several; petioles slender, 6–12 cm. long, one to three times as long as their leaflets, stipules linear-setaceous, 10–12 mm. long, the free part widely divergent; leaflets seven to nine, cuneate or cuneate-obovate, rounded, truncate, or emarginate at apex, usually apiculate, glabrous above, sparsely appressed-pubescent beneath, 20–70 mm. long, 6–16 mm. wide; peduncles 2–8 cm. long, racemes 6–30 cm. long, flowers subverticillate in about four to eight whorls or groups, spreading in anthesis, becoming ascending upon withering, 12–17 mm. long; bracts early deciduous, linear, 6–10 mm. long; pedicels spreading-pubescent with very short hairs, 4–6 mm. long; calyx bracteolate, subappressed-pubescent, the upper lip deeply two-toothed or bifid, about 5 mm. long, the lower lip lanceolate, entire and acute or three-toothed, 7–8 mm. long; banner suborbicular, about 14 x 13 mm. including the claw, glabrous, blue with yellow center turning violet, or rarely bluish white, wings 12–14 mm. long, about 8 mm. wide, blue or rarely nearly white, more or less ciliate at the base above the claw, keel stout, 12–14 mm. long, the point upturned, distinctly ciliate near the claw both above and below, purple-tipped or orange-tipped in the albinos, otherwise whitish; pods about 50 mm. long, 9–10 mm. wide, loosely pubescent or villous with hairs 0.5 to 1.5 mm. long, ovules eight to ten; seeds oblong, 3.5–5 mm. long, much marbled with dark brown, with a pair of contiguous whitish spots embracing the raphe, the hilum deeply sunken in a protruding ring: axial root normally vertical.

This is the plant that has been known as *L. affinis* Agardh, since Wäfson reviewed the genus in 1873 (Proc. Am. Acad. **8**: 517), but the specimens so marked in the Lindley Herbarium

(now at Cambridge University, England) are not this species. Indeed, Dr. Greene, in 1891 (Flora Franciscana **1**: 40), expressed doubt that our robust, succulent annual is the true *L. affinis*, and I have long felt that Agardh's description does not satisfactorily apply to same. It remained, however, for Miss Alice Eastwood to unearth the needed evidence, and her photograph of Lindley's specimen labelled *L. succulentus* shows said specimen to be of this species. Likewise, her photographs of the specimens labelled *L. affinis* Agardh show equally well that same should not be referred to this robust species, but rather to *L. nanus*, a species which will be treated in a later paper. These are the conclusions arrived at by Miss Eastwood with the specimens before her.

Koch knew the species as a garden plant under the name *L. succulentus* and quotes Biedenfeld's Garten Jahrbuch as his

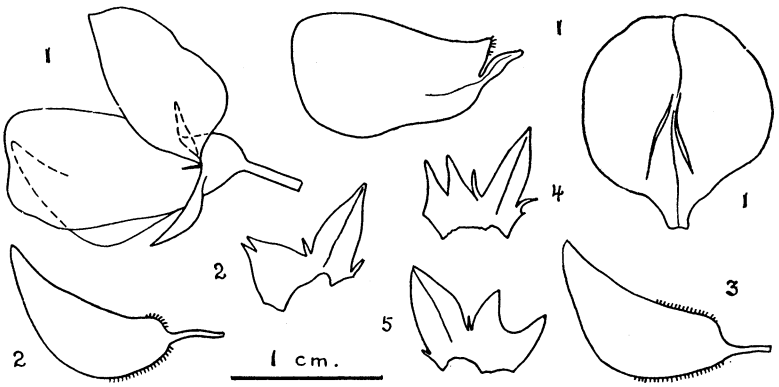

FIG. 76. LUPINUS SUCCULENTUS Dougl. 1. *C. P. Smith 1406* (CPS); 2. *K. Brandegee* (UC 81964); 3. *Edna Hannibal* (DS 87569); 4. *L. R. Abrams 4224* (DS); 5. *K. Brandegee* (UC 187796).

only authority for attributing the name to Douglas. He also states that the same species was distributed from Darmstadt as *L. Liebmanni* and from Geneva as *L. purpureus* Del. Considering the species to be undescribed, he drew up in 1861 a description in German, accrediting the species to Douglas and suggesting that its native home must be assumed to be California or Oregon. As his description is not readily available in this country, it is reproduced here:

Die ganze, mehr neidrig bleibende Pflanze ist mit Ausnahme der Oberfläche der Blätter sehr fein behaart; 9 länglichkeilförmige Blättchen mit zurückgebogener Spitze; Nebenblättchen wenig angewachsen, borsten-

förmig, aufrecht; Aehre gestielt, kurz, aus wenigen (meist nur 3) Quirlen bestehend; Deckblätter länger als die Knospen; Deckblättchen klein und oft undeutlich; Oberlippe 2 theilig, kürzer als die ganze Unterlippe; Schiffchen an der Basis des Randes gewimpert.

Diese durch ihre dunkelen, schwarzvioletten Blüthen ausgezeichnete und sehr zu empfehlende Art scheint noch gar nicht beschrieben zu sein. Obwohl Douglas als Autor angegeben ist und man vermuthen muss, dass Kalifornien oder das Oregon-Gebiet Vaterland sind, so haben wir den Namen doch nur in Biedenfeld's Garten Jahrbuche (im 1. Hefte S. 292) gefunden. Aus welcher Zeitschrift der Verfasser die Pflanze entlehnte, wissen wir nicht. Neuerdings ist sie weider aus dem Darmstädter botanischen Garten als L. Liebmanni, aus dem Genfer als L. purpureus Del. verbrietet worden. Wir vermuthen, dass die Namen in dem Verzeichnisse irgend eines botanischen Gartens aufgestellt wurden.

Koch also here recorded his opinion that the species seems to be related to *L. arvensis* Benth. and to *L. ramosissimus* Benth., a Colombian species collected by Hartweg, and especially to the plant illustrated in plate eleven of the Botanical Register for 1847 and there named *L. Ehrenbergii*. Evidently some one claimed this species to be the same as *L. densiflorus* Benth.; for Koch, in 1867 (Ind. Sem. Hort. Berol., App. 1: 11), published a Latin diagnosis and stated that it differed from *L. densiflorus* in its fragile stems and branches and violet flowers. Since this description is likewise difficult of access, I reproduce most of it here:

Annuus, humilis, ramosus, fragilis, puberulus; stipulae setiformes, erectae, paululum adnatae; folia 9-foliolata, 3-pollicaris; petiolus longitudine folia aequans; . . . foliolis supra glaberrimus subtus puberulis oblongis, sed ad basin magis attenuatis, apice breviter cuspidato, recurvo; . . . spica verticillata, verticillis distantibus; . . . labium superius bifidum, inferius lanceolatum, integrum; . . . vexillum et alae violaceae, . . . carina albida, ad partem superiorem violacea, apice flavescente; legumen pilosum, inter semina constrictum.

Species per longum tam tempus in hortis culta e California nec non e terris mexicanis sine dubio allata, accredit ad *L. densiflorus* Benth., differt tamen fragilitate caulis ramosumque et floribus violaceis. Nusquam descripta esse videtur, sed nupperime iterum in hortis botanicis nominibus: Lupini Liebmannii et purpurei occurrit.

There is a sheet of this species, marked "*Lupinus succulentus* Douglas, 1843", in a large old collection of European garden plants recently secured by Stanford University. Thus, I consider it advisable to accept this name for this species, which otherwise is without a proper botanical name. Douglas could hardly have overlooked the species during his sojourn in California, and certainly a more appropriate name could not be found. I cannot

follow Watson (Proc. Am. Acad. **8**: 538. 1873; and Bib. Index 236. 1878) in assuming that this "is probably but a garden form" of *L. densiflorus*, nor accept his application of Agardh's name to this species. Koch might have said more about the pods and seeds, but his "legumen . . . inter semina constrictum" and his comparison of the species with *L. arvensis*. *L. ramosissimus*, and *L. Ehrenbergii* do not point to a confusion with *L. densiflorus*.

The species is so common in the San Francisco Bay region that I will omit citation of many specimens examined. An albino form (petals pale bluish white) was common in 1921, in and near the mouth of Alum Rock Canyon, Santa Clara County. This was mostly in pure patches, but sometimes associated with pale blue, or the normal, dark blue, form. Seeds were secured from marked colonies, but those from the palest-flowered plants were heavily pigmented, perhaps averaging even darker, rather than paler, than is normal for the species.

CALIFORNIA. Alameda County: Berkeley, Feb., 1899, *H. P. Chandler 239* (UC); Livermore, April, 1904, *A. A. Heller 7320* (B, UC); Niles, June, 1918, *H. A. Walker 5006* (UC); Sunol Valley, June, 1916, *L. R. Abrams 5699* (DS). Butte County: Chico, *A. A. Heller 12983* (UCX). Colusa County: College City, 1905, *Alice King* (UC); Sycamore Slough, Sacramento River, April, 1917, *R. S. Ferris 621* (DS). Contra Costa County: Brentwood, May, 1893, *A. Eastwood* (CA); Bryon Springs, March, 1914, *A. Eastwood* (CA); Concord, March, 1914, *A. Eastwood* (CA); Martinez, April, 1862, *W. H. Brewer 996* (UC). Fresno County: Alcalde, March, 1892, *T. S. Brandegee* (CA); Alcalde, March, 1893, *A. Eastwood* (CA); Huron, March, 1893, *A. Eastwood* (CA). Kern County: Sunset Oil Wells, March, 1893, *A. Eastwood* (CA). Los Angeles County: Avalon, Santa Catalina Island, May, 1920, *G. L. Moxley 732* (CPS); Claremont, April, 1904, *C. F. Baker* (CA); Elysian Hills, Feb., 1903, E. Braunton (UC); Los Angeles, April, 1901, *E. D. Palmer* (UC); Redondo, San Pedro Hills, March, 1903, *L. R. Abrams 3141* (DS); Santa Catalina Island, May, 1916, *K. Brandegee* (UC). Monterey County: Carmel-by-the-Sea, March, 1910, *Alice D. Randall* (DS); Castroville, *T. S. Brandegee* (CA); Jolon Grade from King City, April, 1920, *C. D. Duncan 78* (DS); Pacific Grove, Pebble Beach, April, 1909, *L. R. Abrams 4224* (DS); Posts, June, 1893, *A. Eastwood* (CA). Riverside County:

Hemet, May, 1904, *C. F. Baker 4189* (UC, DS). Sacramento County: Sacramento, April and May, *Edna Hannibal* (DS). San Benito County: Idria, May, 1893, *A. Eastwood* (CA); San Benito, May, 1918, *A. Eastwood* (CA). San Bernardino County: San Bernardino, April, 1888, *S. B. & W. F. Parish* (UC), and March, 1901, *S. B. Parish* (DS). San Diego County: Campo, April, 1920, *A. Eastwood* (CA); La Jolla, April, 1903, *T. S. Brandegee* (UC), and March, 1914, *F. E. & E. S. Clements* (UC); Linda Vista, May, 1894, *T. S. Brandegee* (UC); Point Loma, April, 1913, *A. Eastwood* (CA); San Diego, June, 1885, *Fanny E. Fish* (UC), and March, 1889, *C. R. Orcutt* (CA), also April, 1905, *K. Brandegee* (DS, UC). San Francisco County: Twin Peaks trail, April, 1921, *Bertha Dold 105* (CPS). San Joaquin County: Tracy, April, 1903, *C. F. Baker 2908* (CA). San Luis Obispo County: San Luis Obispo, May, 1882, *M. E. Jones* (CA), April, 1886, *M. Miles* (CA), July, 1911, *K. Brandegee* (UC), and June, 1914, *C. P. Smith 2851* (CPS); San Luis Valley, March, 1882, *Mrs. R. W. Summers* (UC). San Mateo County: Crystal Springs Lake, April, 1896, *A. Eastwood* (UC); Portola, May, 1903, *A. D. E. Elmer 4827* (CA, DS); La Honda summit, May, 1900, *W. R. Dudley* (DS); San Mateo ravine, April, 1894, *W. R. Dudley* (DS); San Pedro, June, 1903, *A. D. E. Elmer 4681* (CA, DS). Santa Barbara County: Ellwood, May, 1908, *A. Eastwood 2* (CA); Santa Cruz Island, April, 1888, *T. S. Brandegee* (UC), July-Aug., 1886, *E. L. Greene* (CA), and June, 1918, *A. Eastwood* (CA); Santa Maria River, June-July, 1906, *A. Eastwood 329* (CA). Santa Clara County: Alum Rock Park, April, 1907, *A. A. Heller 8471* (CPS, DS), Feb., 1921, *C. P. Smith 3212*, albino, and *3213*, normal colored (CPS); Loma Prieta, April, 1894, *J. B. Davy 631* (UC); Los Altos, April, 1894, *W. R. Dudley* (DS); Saratoga, June, 1915, *L. R. Abrams 5260* (DS); Stanford University, April, 1903, *A. D. E. Elmer 4920* (CA, DS), and May, 1902, *C. F. Baker 858* (CA, UC); Campbell, March, 1921, *Claribel Boesch 101* (CPS); Evergreen, March, 1921, *Lotta Bland 101* (CPS); Madrone Packwood School, April, 1921, *Mrs. A. F. Cochrane 102* (CPS). Santa Cruz County: Chittenden, April, 1921, *C. P. Smith 3259* (CPS); Ellicott, June, 1908, *C. P. Smith 1455* (CPS). Shasta County: Anderson, April, 1914, *L. E. Smith 139* (CA). Solano County: Cordelia, April, 1902, *Heller & Brown 5369* (B, DS); Vacaville, May, 1891, *W. L. Jepson* (DS), and May, 1903, *C. F. Baker 5071* (DS, UC). Sonoma

County: Petaluma Valley, April, 1908, *C. P. Smith 1382* (CPS). Sutter County: Marysville Buttes, April, 1915, *A. A. Heller 11,792* (CA, DS, UCX); West Butte, April, 1917, *R. S. Ferris 690* (DS); Yuba City, April, 1891, *W. L. Jepson* (UC). Tehama County: Red Bluff, May, 1914, *L. E. Smith 670* (CA). Ventura County: Ojai Valley, April, 1896, *F. W. Hubby 41* (UC). Yolo County: Davis, April, 1915, *P. B. Kennedy 21* (UCX); Yolo, June, 1914, *C. P. Smith*, seed only (CPS).

LOWER CALIFORNIA. Carysito, April, 1885, *C. R. Orcutt* (CA).

ARIZONA. Gila County: Roosevelt Dam, April 1917, *A. Eastwood 6286* (CA), and May, 1919, *A. Eastwood* (CA).

The distribution of this plant is thus seen to be from Shasta County to northern Lower California, the occurrence at Roosevelt Dam, Arizona, being certainly due to a casual introduction of seed from California. Variations are not particularly well-marked, except in two cases, as indicated below:

1b. **Lupinus succulentus Layneae** var. nov.

Humilis ramis decumbentibus, villosus pilis pandentibus 2 mm. longis, leguminibus aeque villosis.

Depressed, 1 dm. tall, with decumbent branches and short racemes, densely villous with hairs 2 mm. long even on the pods.

CALIFORNIA. San Mateo County: Farallon City, June, 1918, *K. Brandegee* (TYPE, UC 187796).

Mrs. Brandegee's maiden name was Mary Katharine Layne.

1c. **Lupinus succulentus Brandegeei** var. nov. [FIG. 77.]

Humilis, erectus, foliolis maximis prope 20 mm. longis, floribus 9-10 mm. longis, vexillo 10 mm. longo, 7.5 mm. lato, alis apice non truncatis, carina ad basin super paulum ciliata.

Much reduced in stature and size of flowers; about 1 dm. tall, largest leaflets about 20 mm. long, flowers 9-10 mm. long, banner about 10 x 7.5 mm., wings not truncate at the apex, keel less ciliate above.

LOWER CALIFORNIA. Comondu, Feb., 1889, *T. S. Brandegee*

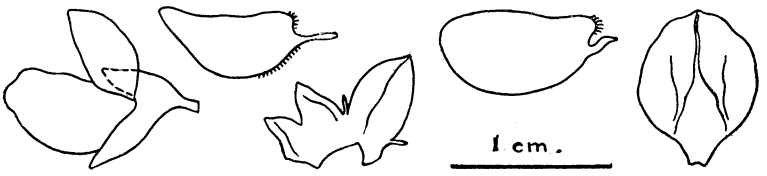

FIG. 77. LUPINUS SUCCULENTUS BRANDEGEEI C. P. Smith. *T. S. Brandegee* (UC 83498).

(TYPE, UC 83498); San Julio, April, 1889, *T. S. Brandegee* (UC), and April, 1919, *T. S. Brandegee* (CA).

MICRANTHI

L. micranthus and its nearest relatives comprise the largest and most difficult group of the annual species of the subgenus *Lupinus* Watson. Variations in shape and size of flowers, leaflets, pods, and seeds produce conspicuous extremes which have suggested "new species" not a few in number. That botanists have appreciated these variations is evidenced by the following list of published names:

L. bicolor Lindl. Bot. Reg. **13**: *pl. 1109*. 1827.
L. micranthus Dougl.; Lindl. Bot. Reg. **15**: *pl. 1251*. 1829.
L. nanus Dougl.; Benth. Tran. Hort. Soc. II. **1**: 409. 1835.
L. affinis Agardh, Syn. Gen. Lup. 20. 1835.
L. Aschenbornii S. Schauer, Linnaea **20**: 739. 1847.
L. micranthus microphyllus Wats. Proc. Am. Acad. **8**: 535. 1873.
L. niveus Wats. *ibid.* **11**: 126. 1876.
L. trifidus Torr.; Wats. *ibid.* **12**: 250. 1877.
L. chihuahuensis Wats. *ibid.* **21**: 423. 1886.
L. carnosulus Greene, Bull. Cal. Acad. **2**: 144. 1886.
L. umbellatus Greene, *ibid.* **2**: 145. 1886.
L. pachylobus Greene, Pittonia **1**: 65. 1887.
L. polycarpus Greene, *ibid.* **2**: 171. 1888.
L. rostratus Eastwood, Proc. Cal. Acad. II. **6**: 424. *pl. 56*. 1896.
L. persistens Heller, Muhlenbergia **2**: 62. 1905.
L. vallicola Heller, *ibid.* **4**: 40. 1908.
L. apricus Greene, Leaflets **2**: 67. 1910.
L. vallicola apricus C. P. Smith, Muhlenbergia **6**: 135. 1911.
L. hirsutulus Greene, Leaflets **2**: 152. 1911.
L. sabulosus Heller, Muhlenbergia **7**: 9. 1911.
L. Pipersmithii Heller, *ibid.* **7**: 93. 1911.
L. strigulosus Gandoger. Bull. Soc. Bot. France **60**: 461. 1913.

In addition to accounting for these published names, the scope of these papers will necessitate disposing of some seven herbarium names. Of the above, only one species will be treated at this time, the remainder being scheduled for attention in subsequent papers.

The name *Bicolores* would have been a more appropriate appellation for this group; but the name here employed has been in use for some time. The flowers measure 6–16 mm. in length and are always bicolored but are certainly not always small. They are usually verticillate; but the racemes are sometimes reduced to one umbel-like whorl, and in one form the flowers are strictly scattered. The keel is normally ciliate on the upper

margin near the point, a character not shared by any other group of North American annual lupines; however, two of the forms lack this ciliation. The upper surface of the leaves is almost always with at least a few short hairs.

2. LUPINUS NIVEUS Wats. Proc. Am. Acad. **11**: 126. 1876. [FIG. 78.]

Apparently annual or biennial with persistent petioled cotyledons, erect, 3–4 dm. tall, branched well above the base, densely velvety tomentose above the cotyledons, which are fleshy, glabrous, the blades about 20 mm. long, 12 mm. wide: leaves velvety on both sides, petioles 6–8 cm. long, leaflets eight or nine, rounded or angled at the apex, 30–40 mm. long, 9–12 mm. wide: peduncles 5–8 cm. long, racemes 8–12 cm. long, loosely few-flowered, bracts deciduous, linear, 5–8 mm. long; flowers 10 mm. long, spreading or subdrooping, pedicels 4–6 mm. long; calyx practically ebracteolate, the lips equal in length, about 5 mm. long, the upper cleft or bifid, over 4 mm. wide, the lower bluntly two-toothed, barely 3 mm. wide. petals broad, deep blue, banner suborbicular, about 10 x 10 mm., greenish

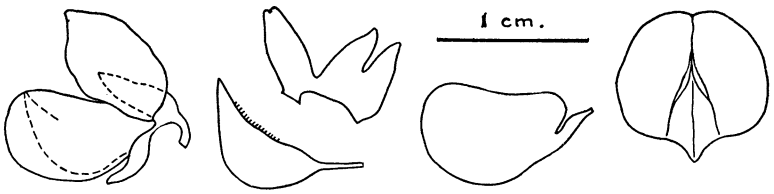

FIG. 78. LUPINUS NIVEUS Wats. *E. Palmer 861* (G, US).

yellow in the center, wings about 10 x 7 mm., only slightly ciliate on the upper margin near the very sharp upturned point; pods yellow, 40–50 mm. long, 8–10 mm. wide, stout, ovules four or five; seeds pale, obscurely spotted, mostly 5–6 mm. long.

This is a very distinct, isolated, insular species not closely related to any other known species; but as I see it, better lined up with *L. nanus*, at least for the present. For a long time I was misled by Watson's clause, "allied to *L. leucophyllus*", and thus had difficulty in classifying this plant.

LOWER CALIFORNIA: Guadelupe Island, 1875, *E. Palmer 25*. (G); 1889, *E. Palmer 861* (G, US); 1893, *F. Franceschi* (US).

My thanks are especially due to Miss Alice Eastwood for the use of unpublished notes and to Dr. J. H. Barnhart for important bibliographical help.

The abbreviations used herein in the citation of specimens may be identified by reference to the following list:

B, Brooklyn Botanic Garden;
CA, California Academy of Science;
CPS, private herbarium of the writer;
DS, Dudley Herbarium, Stanford University;
G, Gray Herbarium, Harvard University;
UC, Department of Botany, University of California;
UCX, Division of Agronomy, University of California Experiment Station;
US, United States National Herbarium.

SAN JOSE, CALIFORNIA